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ABSTRACT

Two experiments were conducted to investigate how event representation might operate in preschool children's understanding of the temporal terms "before" and "after." The first study, involving 3- and 4-year-olds (a total of 16 of each age) varied the arbitrariness of event sequences. Sixteen stories, each containing five events and concerning typical activities in the lives of preschool children, were used. Results indicated that, contrary to previous claims, preschool children do understand these temporal terms. The second study--involving 48 children categorized by age into groups with members 3, 4, and 5 years of age--varied the arbitrariness/logicality of event order and assessed children's comprehension and production. A new comprehension measure and two measures of production were used. Results indicated that very young children do give indications of understanding the temporal terms under conditions where event representation exists and task demands are minimal. Event representation was not found to be sufficient where task demands are great or where event representation is irrelevant to the task. Furthermore, familiarity with the basic type of event in the nonlinguistic context was shown to be insufficient to elicit the young child's knowledge of "before" and "after"; it was therefore concluded that the temporal structure of the event is an essential ingredient in supporting the child's performance. Results also suggested the need for devising very simple tasks that rely specifically on event representation in order to tap young children's knowledge of other temporal terms. (RH)

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# Contextual Controls of Competence with Before and After

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Contextual Controls of Competence with Before and After

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French's (1981, 1983) examination of Nelson's (1981) script data showed that very young children are able to use appropriate relational terms to describe routinely experienced events when those events follow a particular ordering in time. By implication, this work indicated that preschool children are capable of cognitive and linguistic abilities they have previously been said to lack. It also suggested that young children's understanding of ordered events in their lives can serve an essential function in experimental paradigms that attempt to assess particular cognitive and linguistic abilities.

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The child's appropriate use of causal and relational terms is of special importance to developmental psycholinguists because it gives us clues to understanding the ways in which logical and linguistic abilities intersect in development. With French and Nelson's work in mind, I conducted a series of studies designed to show how event representation might operate in the child's understanding of one particular pair of relational terms, the temporal terms before and after. These terms were specifically chosen because there is a research literature spanning over two decades that has claimed that preschool children

are incapable of full understanding of these terms, and there are two major theoretical accounts that have been proposed to explain why preschoolers have this alleged incapacity.

Piagetian investigators have claimed that young children are incapable of understanding before and after because they do not yet have a knowledge of the logical concept of reversibility that underlies the meanings of these terms (Piaget, 1927; Fraisse, 1963; Cromer, 1968; Ferreiro & Sinclair, 1971). On the other hand, Eve Clark (1971) proposed a developmental model in which the child was said to learn before and after one term at a time, before prior to after, as the child learns meaning components or semantic features said to be inherent in these terms. Clark claimed that full understanding of both terms was not achieved by the child prior to age 5 or 6.

Researchers of both orientations, however, all tested preschool children using event sequences that provided no support to performance in the extralinguistic context, that is, in the content and temporal structure of the stimulus sequences. An arbitrarily-related sequence such as Ferreiro and Sinclair's (1971) The girl pushes the truck before the boy washes the car provides no clue to the meaning of the temporal term (before) from the order of events. In

contrast, a logically-related sequence such as French and Brown's (1976) Raggedy Ann takes her hat off before she brushes her hair allows the child to deduce the meaning of the term before from knowing the real world order of events. However, such sequences do not test whether the child understands the relational term or only the real world logical sequence. The problem is to provide support for understanding without destroying the need for understanding. If reliable evidence for early understanding of before and after within the context of real world orderings of events can be found, it would compel a major revision of the currently available developmental models of relational terms. Such a revision would have to assign a central responsibility to preschoolers' event representations in accessing and perhaps in acquiring this understanding.

The first study was conducted in collaboration with Lucia French (Carni & French, 1982). We composed 16 five-event stories that concerned typical activities in the lives of preschool children. Half of the stories were modelled on the results of Nelson's (1981) script data and followed a relatively set order of events, for example, stories about a Birthday Party or Grocery Shoppping. The other half consisted of sequences in which the events were arbitrarily related, such as Hide and Seek. (Examples of

the stories are listed on the handout.) The stories were illustrated with arrays of line drawings. Our subjects were 16 3- and 16 4-year-old children. We read them the stories one at a time and asked them to answer questions asking 'What happened' either before or after the middle event. (Suitable controls for order effects were incorporated into the design.) Since there was no way for the subjects to deduce the meanings of before and after in either the scripted or arbitrary sequences, given the question paradigm used here, we could assume that correct responses to the questions implied a prior understanding of the temporal terms.

A repeated measures ANOVA comparing the numbers of correct responses to the questions in scripted and arbitrary sequences showed a significantly better performance with scripted than with arbitrary sequences. There was also a main effect of age, with 4-year-olds performing significantly better than 3-year-olds. There was also a significant interaction between age and sequence type. See Table 1. T-tests showed that the 4-year-olds' performance was significantly above chance for both scripted and arbitrary sequences ($t(15) = 4.53$, $p < .001$), The 3-year-olds' performance was significantly above chance for the scripted sequences only ($t(15) = 4.57$, $p < .001$), and was significantly greater for the scripted than for arbitrary sequences ($t(15) = 3.29$, $p < .01$).

The data of this study showed that, contrary to previous claims, preschool children do understand both before and after. Four-year-olds' understanding of these terms seems to be accessible across different types of extralinguistic context, while 3-year-olds' understanding seems to depend upon their cognitive representation of events that follow a real world or logically-related temporal order. Since both types of story were within the range of the 3-year-olds' experience, a fact borne out by our asking the subjects whether or not they had participated in events like each one used in the testing, it was apparently the temporal structure of the sequences and not the familiarity with the basic events alone that made the difference in the younger children's responses.

A second study following up these results was conducted because of numerous reports in the literature on the development of temporal terms that young children give different patterns of response in different testing paradigms that purport to be measuring exactly the same phenomena (Johnson, 1975; Coker, 1977). That is to say, young children's test responses may not accurately reflect their knowledge of the temporal terms. French's discussion pointed out that experimental methods may serve to conceal (as well as reveal) preschoolers' cognitive and linguistic abilities. So it is possible that with certain task demands

preschoolers may fail to demonstrate their knowledge of before and after even with the presence of known events in the extralinguistic context. In order to assess the strength of event representation in accessing preschoolers' knowledge of before and after, I tested both comprehension and production of these terms across logically-related and arbitrarily-related event sequences using a different measure of comprehension and 2 measures of production.

In this study there were 48 subjects, equally divided into groups of 3-, 4-, and 5-year-old children. In one test, I composed 8 four-event sequences that could be assumed to be familiar to young children. Half of the sequences followed a logically-invariant event order such as the events in 'Making a Phone Call' and the other half followed an arbitrary event order such as the events in 'Dressing a Doll.' (Examples of the sequences appear on the handout.) I enacted the sequences once and the subjects enacted them twice following me. For each sequence I asked the subjects to answer 4 questions asking 'What happened' before or after certain events in the sequence--the comprehension question--and also 3 questions asking 'When' one of the events occurred--the production questions.

In a second test, I attempted to measure production of before and after by asking the subjects to repeat 36 two-event sentences conjoined by these terms. One-third of the sentences followed a logically-invariant event order such

as 'Simple Simon put on his socks before he tied his shoes'; one-third followed an arbitrarily-related event order such as 'Simple Simon went inside before he tied his shoes'; and one-third reversed the logical order of events such as 'Simple Simon tied his shoes before he put on his socks.' (Examples of the sentences controlled for the temporal term and order of mention of events appear on the handout.) I expected better performance with logically-invariant than with arbitrarily-related sequences. With the illogical sequences, I expected that the subjects would either reverse the temporal term or the event order in accord with their knowledge of the appropriate ordering of events.

Comprehension

A repeated measures ANOVA comparing the numbers of correct responses made to the before/after questions of the toy task showed a main effect of age but not of sequence type ($F(2, 45) = 3.64$, $p < .04$). The 4- and 5-year-old performed well across sequence types but the 3-year-olds' performance was not substantially above chance level for either sequence type. See Table 2.

However, further analysis of the data showed an interesting phenomenon in the 3-year-olds' responses; these subjects appeared to be using nonlinguistic strategies of response that treated logical and arbitrary sequences differently, ironically producing an (artificial) increase

in the number of correct responses in the arbitrary condition.[1] Thus, event knowledge did seem to influence performance among the youngest subjects, although not by pointing out an understanding of the temporal terms.

Because it was impossible to tell whether the 3-year-olds had no knowledge of before and after or had a prior understanding of these terms that they were not able to use under these testing conditions, I gave them the Carni and French picture test as well. An ANOVA of the replies to the before/after questions across sequence types replicated the direction of difference between a and l* sequences of the original study although the difference did not reach significance. T-tests showed that the performance with logical sequences was significantly above chance ($t(15) = 3.59$, $p < .01$), while the performance with arbitrary sequences was not. See Table 2. These data indicate that the 3-year-olds did have an understanding of before and after that was supported by their knowledge of event orders in the logical condition.

However, at the individual level, the subjects who performed well with the logical sequences of the picture task did not perform correspondingly well with the logical sequences of the toy task. That is to say, event knowledge did not facilitate the same subjects' performance across tasks. This means that the function of event representation in supporting early understanding of before and

* arbitrary (a) and logical (l)

after was enhanced by some feature of the picture task or weakened by some feature of the toy task.

Production

The subjects' responses to the when questions used either the terms before and after, the term when, or were atemporal. The proportions of total responses made to the when questions for each type of response by age and sequence type appear in Table 3. For the before/after responses, there was an increase in the frequency and accuracy with age but no difference in the use of the temporal terms across sequence types.

Repetition

The subjects' responses to the repetition task either (1) preserved the meaning of the stimulus sequences; (2) reversed the meaning of the stimulus sequences; or (3) deformed the meaning of the stimulus sequences. The mean proportion of responses for each of these categories by age and sequence type appear in Table 4. An age by sequence type repeated measures ANOVA carried out on the responses to each category revealed no main effect of either age or sequence type and no interactions. In general, the numbers of correct repetitions increased with age and the error pattern shifted with age in a direction that indicated increasing understanding of before and

after (increase in reversals, decrease in deformations with age). Event knowledge did not appear to facilitate performance in this task. Still, an examination of the individual patterns of response suggested that the subjects were indeed sensitive to the different types of stimulus sentences although this sensitivity was not reflected in the means.

This information was assessed through a Chi-Square analysis of the numbers of subjects showing different patterns of relative responses between sequence types for every pair of sequence types. See Table 5. When parsed this way, the data indicated that different types of context-sensitive response strategies were operative at each age level. Both the numbers of strategies and the numbers of subjects using these strategies decreased with age, indicating a developmental shift in the use of event knowledge in the responses.

## Conclusions

The study reported here corroborates the results found by Carni and French in showing that children as young as 4 years of age have an understanding of before and after that can be experimentally assessed even when the events in the extralinguistic context follow no previously established temporal order. It also supports the finding that children as young as 3 years of age have an

understanding of these terms that seems to lend itself to assessment only when the events in the extralinguistic context follow a real world or established temporal order. The study also indicates that very young children's cognitive representation of event orders is not sufficient to elicit their knowledge of before and after under all experimental conditions. These children show a sensitivity to the demands of experimental tasks that may induce response strategies and actually override their knowledge of the temporal terms.

The results of the second study indicate that when different experimental paradigms include real world or established orders of events in the extralinguistic context, very young children produce response strategies that are specific to both the paradigm and the context, whether or not they have a prior knowledge of before and after. For reasons that are not fully clear, certain of these paradigm-context-specific response strategies will facilitate performance when the child starts with an initial understanding of these terms. It is possible that, in this research, the toy task proved to be more difficult than the picture task because the subjects had to recall the actions they performed on the toys during questioning. In the picture task, the actions of the characters were depicted in the drawings and remained in view in the order

in which they occurred after the stories were read.

Thus, event representation seems to be necessary to elicit the young child's knowledge of before and after but is not sufficient on its own. While this conclusion makes preschoolers' knowledge of before and after and the role of real world orderings of events in tapping such knowledge more difficult to demonstrate, it also underscores the critical influence of experimental methods in determining the kinds of data we obtain from the child; the data we obtain, in turn, influence our ideas on how temporal and relational terms are understood and acquired. On these grounds alone the existing models of the development of understanding of relational terms may be challenged.

The present work has shown that very young children do give understanding of before and after under conditions where event representation exists and the task demands are minimal. Event representation is not enough where the task demands are great or where event representation is irrelevant to the task, as may be the case with repetition. Furthermore, familiarity with the basic type of event in the nonlinguistic context is not enough to elicit the young child's knowledge of before and after; the temporal structure of the event is an essential ingredient in supporting the child's performance with these terms. With

respect to the results of these studies of before and after, there is now a need for devising very simple tasks that rely specifically on event representation in order to tap young children's knowledge of other temporal terms as well.

Footnotes

[1]Typically, when the subjects did not know the meaning of the temporal term, they answered by reporting the next event in time, regardless of whether the question was a before or after one. For event #4, however, the question was always a before question since there was no next event in time. This posed a problem. For arbitrary stories, where there was no logical conclusion to the event, the subject could guess by choosing a previous event in time. This would always be a correct response to the question. For the logical stories, the subjects knew that choosing a previous event would be incorrect because it would be illogical to the sequence and therefore gave many 'I don't know' responses or said that 'nothing' happened (meaning 'nothing' came next in time following event #4). This would always be an incorrect response to the question.

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Table 1: Carni & French (1981)-Study 1, Comprehension

Mean Proportion of Correct Responses

| | Pictures | |
|---|---|---|
| Age | Logical | Arbitrary |
| 3 | .74 | .49 |
| 4 | .84 | .79 |

Sequence (Logical/Arbitrary): $F(1,30) = 11.2$ $p < .005$
Age: $F(1,30) = 8.4$ $p < .01$
Interaction: $F(1,30) = 4.5$ $p < .05$

Table 2: Carni (1982)- Study 2, Test 1, Comprehension

Mean Proportion of Correct Responses (Comprehension)

| | Toys | | Pictures | |
|---|---|---|---|---|
| | Logical | Arbitrary | Logical | Arbitrary |
| Age | | | | |
| 3 | .68 | .73 | .70 | .59 |
| 4 | .83 | .82 | | |
| 5 | .90 | .89 | | |

Age: $F(2, 45) = 3.64$ $p < .04$

Chance = 0.62 Chance = 0.40

Table 3: Carni (1982)- Study 2, Test 1, Production

When Questions: Proportion of Total Responses by Sequence Type per Response Category[a]

| Age | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|
| | L[c] | A[d] | L | A | L | A |
| (1)[b] Before/ After | .30 | .38 | .54 | .64 | .75 | .85 |
| (2) When | .16 | .05 | .18 | .10 | .11 | .03 |
| (3) Atemporal | .45 | .46 | .28 | .26 | .13 | .12 |

a These proportions do not sum to 100% because general temporal markers such as "Today" and "Now" were not included.

b Category (1) also includes responses made by temporal markers such as "First", "Next" and "Last". These responses were not used frequently enough to constitute a separate category.

c Logical

d Arbitrary

Table 4: Carni (1982) - Study 2, Test 2, Production

Repetition

| Age | Logical | Logical Reversed | Arbitrary |
|---|---|---|---|
| | Proportion of Correct Responses | | |
| 3 | .65 | .68 | .66 |
| 4 | .78 | .70 | .82 |
| 5 | .80 | .77 | .84 |
| | Proportion of Reversals | | |
| 3 | .22 | .16 | .16 |
| 4 | .16 | .16 | .13 |
| 5 | .12 | .17 | .10 |
| | Proportion of Deformations | | |
| 3 | .13 | .16 | .18 |
| 4 | .06 | .14 | .05 |
| 5 | .08 | .06 | .06 |

Table 5: Carni (1982)- Study 2, Test 2, Production (Individual Strategies)

Repetition: Chi-Square Cells

Number of Subjects Showing Different Patterns of Relative Response[a] between Conditions

| Logical/Arbitrary | | | |
|---|---|---|---|
| Age | L=A | L>A | A>L |
| 3 | 1 | 8 | 7 |
| 4 | 8 | 4 | 4 |
| 5 | 9 | 3 | 4 |

$X^2$ df = 4 = 10.4 $p < .05$

| Logical/Logical Reversed | | |
|---|---|---|
| L=LR | L > LR | LR > L |
| 3 | 5 | 8 |
| 7 | 8 | 1 |
| 3 | 8 | 5 |

$X^2$ df = 4 = 15.86 $p < .001$

| Logical Reversed/Arbitrary | | | |
|---|---|---|---|
| Age | LR=A | LR > A | A > LR |
| 3 | 4 | 5 | 7 |
| 4 | 8 | 0 | 8 |
| 5 | 3 | 4 | 9 |

a=figures based on numbers of correct responses

INVARIANT: One day Jane and her mother went to the grocery store to buy some food...

hey got a shopping cart. Then Jane sat in the little seat. Her mother pushed the cart around the store and they put food in it. Then they paid for the food. Then they carried the groceries home.

ARBITRARY: Jane's Aunt Sara came to visit one day...

They played with Then they colored in Jane's aunt made pan- Then they sang songs. Then they walked around

FIGURE 1

Examples of Stimulus Sequences for the Toy Task:

| Logical I | Arbitrary I |
|---|---|
| We're going to feed the baby and put her to bed. | We're going to dress the doll for a party. |
| (1) First we fill the bottle. | (1) First we wash her off. |
| (2) Then we close the bottle. | (2) Then we put the beads on. |
| (3) Then we feed the baby. | (3) Then we put the star in her hair. |
| (4) Then we put the baby to bed. | (4) Then we put the flower in her hair. |

Examples of Stimulus Sequences for the Repetition Task:

| | |
|---|---|
| Logical: | |
| Before/Preserve | Simple Simon put on his socks before he tied his shoes. |
| Before/Violate | Before Simple Simon tied his shoes he put on his socks. |
| Logical Reversed: | |
| After/Preserve | After Simple Simon tied his shoes he put on his socks. |
| After/Violate | Simple Simon put on his shoes after he tied his socks. |
| Arbitrary: | |
| Before/Preserve | Simple Simon went inside before he tied his shoes. |
| After/Preserve | After Simple Simon went inside he tied his shoes. |